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**DEPARTMENT OF TRANSPORTATION**

**Federal Aviation Administration**

**14 CFR Part 25**

**[Docket No. FAA-2019-0541; Special Conditions No. 25-758-SC]**

**Special Conditions: The Boeing Company Model 777 Series Airplanes; Seats with Inertia Locking Devices**

**AGENCY:** Federal Aviation Administration (FAA), DOT.

**ACTION:** Final special conditions.

**SUMMARY:** These special conditions are issued for The Boeing Company (Boeing) Model 777 series airplanes. These airplanes will have a novel or unusual design feature when compared to the state of technology envisioned in the airworthiness standards for transport-category airplanes. This design feature is an inertia locking device (ILD) installed in passenger seats. The applicable airworthiness regulations do not contain adequate or appropriate safety standards for this design feature. These special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

**DATES:** Effective [INSERT DATE 30 DAYS AFTER PUBLICATION IN THE FEDERAL REGISTER].

**FOR FURTHER INFORMATION CONTACT:** Shannon Lennon, Cabin and Airframe Safety Section, AIR-675, Transport Standards Branch, Policy and Innovation Division, Aircraft Certification Service, Federal Aviation Administration, 2200 South

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## **SUPPLEMENTARY INFORMATION:**

### **Background**

On December 6, 2013, Boeing applied for Type Certificate No. T00001SE for Model 777 series airplanes. On September 19, 2018, Boeing applied for a change to Type Certificate No. T00001SE for seats with inertia locking devices in Model 777 series airplanes. The Model 777 series airplane is a twin-engine, transport-category airplane with a maximum takeoff weight of 775,000 pounds and seating for 495 passengers.

### **Type Certification Basis**

Under the provisions of title 14, Code of Federal Regulations (14 CFR) 21.101, Boeing must show that the Model 777 series airplanes, as changed, continue to meet the applicable provisions of the regulations listed in Type Certificate No. T00001SE, or the applicable regulations in effect on the date of application for the change, except for earlier amendments as agreed upon by the FAA.

If the Administrator finds that the applicable airworthiness regulations (i.e., 14 CFR part 25) do not contain adequate or appropriate safety standards for Boeing Model 777 series airplanes because of a novel or unusual design feature, special conditions are prescribed under the provisions of § 21.16.

Special conditions are initially applicable to the model for which they are issued. Should the type certificate for that model be amended later to include any other model that incorporates the same novel or unusual design feature, or should any other model already included on the same type certificate be modified to incorporate the same novel

or unusual design feature, these special conditions would also apply to the other model under § 21.101.

In addition to the applicable airworthiness regulations and special conditions, Boeing Model 777 series airplanes must comply with the fuel-vent and exhaust-emission requirements of 14 CFR part 34, and the noise-certification requirements of 14 CFR part 36.

The FAA issues special conditions, as defined in 14 CFR 11.19, in accordance with § 11.38, and they become part of the type certification basis under § 21.101.

### **Novel or Unusual Design Features**

Boeing Model 777 series airplanes will incorporate the following novel or unusual design features:

Seats with inertia locking devices.

### **Discussion**

Boeing will install, in Model 777 series airplanes, Thompson Aero Seating Ltd. passenger seats that can be translated in the fore and aft direction by an electrically powered motor (actuator) that is attached to the seat primary structure. Under typical service-loading conditions, the motor internal brake is able to translate the seat and hold the seat in the translated position. However, under the inertial loads of emergency-landing loading conditions specified in 14 CFR 25.562, the motor internal brake may not be able to maintain the seat in the required position. The ILD is an “active” device intended to control seat movement (i.e., a system that mechanically deploys during an impact event) to lock the gears of the motor assembly in place. The ILD mechanism is activated by the higher inertial load factors that could occur during an

emergency landing event. Each seat place incorporates two ILDs, one on either side of the seat pan. Only one ILD is required to hold an occupied seat in position during worst-case dynamic loading specified in § 25.562.

The ILD will self-activate only in the event of a predetermined airplane loading condition such as that occurring during crash or emergency landing, and will prevent excessive seat forward translation. A minimum level of protection must be provided if the seat-locking device does not deploy.

The normal means of satisfying the structural and occupant protection requirements of § 25.562 result in a non-quantified, but nominally predictable, progressive structural deformation or reduction of injury severity for impact conditions less than the maximum specified by the rule. However, a seat using ILD technology may involve a step change in protection for impacts below and above that at which the ILD activates and deploys to retain the seat pan in place. This could result in structural deformation or occupant injury output being higher at an intermediate impact condition than that resulting from the maximum impact condition. It is acceptable for such step-change characteristics to exist, provided the resulting output does not exceed the maximum allowable criteria at any condition at which the ILD does or does not deploy, up to the maximum severity pulse specified by the requirements.

The ideal triangular maximum severity pulse is defined in Advisory Circular (AC) 25.562-1B. For the evaluation and testing of less-severe pulses for purposes of assessing the effectiveness of the ILD deployment setting, a similar triangular pulse should be used with acceleration, rise time, and velocity change scaled accordingly. The magnitude of the required pulse should not deviate below the ideal pulse by more than

0.5g until  $1.33t_1$  is reached, where  $t_1$  represents the time interval between 0 and  $t_1$  on the referenced pulse shape as shown in AC 25.562-1B. This is an acceptable method of compliance to the test requirements of the special conditions.

Conditions 1 through 5 address ensuring that the ILD activates when intended, to provide the necessary protection of occupants. This includes protection of a range of occupants under various accident conditions. Conditions 6 through 10 address maintenance and reliability of the ILD, including any outside influences on the mechanism, to ensure it functions as intended.

The special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

### **Discussion of Comments**

The FAA issued Notice of Proposed Special Conditions No. 25-19-12-SC for Boeing Model 777 series airplanes, which was published in the *Federal Register* on August 9, 2019 (84 FR 39235). The FAA received responses from one commenter.

Boeing states that, as written, because  $t_1$  is an arbitrary point in the shock pulse, the relevance of  $1.33t_1$  is unclear, and believes this is a typographical error. Boeing further states that the 0.5g deviation below the ideal pulse for the evaluation and testing of less-severe pulses was proposed for airbags where the airbag activates a lower pulses (9g or less). The ILD activates at a higher pulse (14.5g), closer to the pulse specified in the airworthiness requirements. Boeing states that, in this case, a 2g deviation below this ideal pulse is more appropriate and would be acceptable for ensuring the pulse meets the pulse-shape requirement.

The FAA determined that the ideal pulse discussion in the proposed special conditions is consistent with FAA's previous guidance on this issue. The FAA's intent in the Discussion section is to model the less-severe or reduced-pulse test conditions after the ideal pulse defined in AC 25.562-1B, figure 3.1, where  $t_1$  is defined as the rise time. The recommendation to not deviate from the ideal pulse by more than 0.5g until  $1.33t_1$  is intended to ensure an appropriate pulse shape is achieved for such reduced-pulse tests. This is not a typographical error and is consistent with previous policy provided for conducting reduced-pulse tests for seats with airbag systems. This recommendation remains true regardless of the activation setting for the feature under consideration, provided that the activation setting is less than the minimum pulse defined in AC 25.562-1B, figure 3.1, e.g., 16g for a forward test. A 2g deviation from the ideal pulse is discussed in appendix 1 of AC 25.562-1B, and is relevant only when evaluating an actual pulse to the ideal pulse under normal (non-reduced) conditions. Because the Discussion section of this special conditions document is intended to convey an acceptable means for conducting reduced-pulse tests, and is not a regulatory requirement, the content of the Discussion section remains as proposed. However, the FAA recognizes that other means to conduct reduced-pulse tests may be proposed, provided that the applicant can show that the test conditions are scaled appropriately.

Except as discussed above, the special conditions are adopted as proposed.

### **Applicability**

As discussed above, these special conditions are applicable to Boeing Model 777 series airplanes. Should Boeing apply at a later date for a change to the type certificate to

include another model incorporating the same novel or unusual design feature, these special conditions would apply to that model as well.

## **Conclusion**

This action affects only one novel or unusual design feature on one model series of airplanes. It is not a rule of general applicability.

## **List of Subjects in 14 CFR Part 25**

Aircraft, Aviation safety, Reporting and recordkeeping requirements.

## **Authority Citation**

The authority citation for these special conditions is as follows:

**Authority:** 49 U.S.C. 106(f), 106(g), 40113, 44701, 44702, 44704.

## **The Special Conditions**

Accordingly, pursuant to the authority delegated to me by the Administrator, the following special conditions are issued as part of the type certification basis for Boeing Model 777 series airplanes.

In addition to the requirements of § 25.562, passenger seats incorporating an inertia locking device (ILD) must meet the following:

1. **Level of Protection Provided by ILD** — It must be demonstrated by test that the seats and attachments, when subject to the emergency-landing dynamic conditions specified in § 25.562, and with one ILD not deployed, do not experience structural failure that could result in:
  - a. Separation of the seat from the airplane floor.
  - b. Separation of any part of the seat that could form a hazard to the seat occupant or any other airplane occupant.

- c. Failure of the occupant restraint or any other condition that could result in the occupant separating from the seat.

2. **Protection Provided Below and Above the ILD Actuation Condition** — If step-change effects on occupant protection exist for impacts below and above that at which the ILD deploys, tests must be performed to demonstrate that the occupant is shown to be protected at any condition at which the ILD does or does not deploy, up to the maximum severity pulse specified by § 25.562. Test conditions must take into account any necessary tolerances for deployment.
3. **Protection Over a Range of Crash Pulse Vectors** — The ILD must be shown to function as intended for all test vectors specified in § 25.562.
4. **Protection During Secondary Impacts** — The ILD activation setting must be demonstrated to maximize the probability of the protection being available when needed, considering a secondary impact that is above the severity at which the device is intended to deploy up to the impact loading required by § 25.562.
5. **Protection of Occupants other than 50th Percentile** — Protection of occupants for a range of stature from a 2-year-old child to a 95th percentile male must be shown.
6. **Inadvertent Operation** — It must be shown that any inadvertent operation of the ILD does not affect the performance of the device during a subsequent emergency landing.
7. **Installation Protection** — It must be shown that the ILD installation is protected from contamination and interference from foreign objects.



8. **Reliability** — The performance of the ILD must not be altered by the effects of wear, manufacturing tolerances, aging/drying of lubricants, and corrosion.
9. **Maintenance and Functional Checks** — The design, installation, and operation of the ILD must be such that it is possible to functionally check the device in place. Additionally, a functional-check method and a maintenance-check interval must be included in the seat installer's instructions for continued airworthiness (ICA) document.
10. **Release Function** — If a means exists to release an inadvertently activated ILD, the release means must not introduce additional hidden failures that would prevent the ILD from functioning properly.

Issued in Des Moines, Washington, on October 25, 2019.

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